

# ASTLEY COOPER'S CONTRIBUTION TO THE KNOWLEDGE OF DISLOCATIONS AND FRACTURES

INAUGURAL-DISSERTATION

zur Erlangung der Doktorwürde der gesamten Heilkunde  
der Medizinischen Fakultät der Universität Basel

vorgelegt von

PAUL MORRIS DLUGATZ

New York, USA

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genehmigt auf Antrag von Prof. Dr. H. Buess  
Tag der Promotion: 21. Dezember 1967





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## THE LIFE OF COOPER: 1768-1841

Sir Astley Cooper was the most reknown London surgeon during the first quarter of the nineteenth century when London was the leading medical center of the world. He was born on August 23, 1768, at Brooke Hall, near Norwich, England, the fourth son of Samuel Cooper. Astley Cooper's father was a Clergyman who gained some fame for himself by writing pamphlets and articles, mainly of a political and religious nature. His mother also achieved a certain amount of success as authoress of short-story books for children.

As a child, Cooper received lessons at home from his parents and the local schoolmaster, but he did not distinguish himself as a scholar, preferring to spend his time in his own way rather than study. It is interesting to note that the man who was the personification of diligence showed so little ambition as a youngster.

His desire to be trained as a surgeon was undoubtedly influenced by the fact that both his grandfather, Samuel Cooper, and uncle, William Cooper, were respected surgeons of the day. His uncle's position - senior surgeon to Guy's Hospital - and influence also offered certain obvious advantages if he followed the same profession.

And so at the age of sixteen he was apprenticed to his uncle, but six months later he transferred to Henry Cline, surgeon to St. Thomas's Hospital. The association with Henry Cline was to be of tremendous importance to young Cooper. Cline, of the outstanding surgeons of his day, had a beneficial influence on him. Besides stimulating Cooper to work so well, it was Cline who introduced him to the teaching and principles of John Hunter, who was to become the great inspiration in Cooper's life. He soon became a regular visitor at Hunter's lectures.

At this point it might be worthwhile to give a brief sketch of the two hospitals that played such an important role in Cooper's life. Both St. Thomas's and Guy's Hospitals, besides being located opposite one another on



St. Thomas's street, were closely connected in working. The students of both institutions were granted permission to attend the practice and teaching of surgery at both hospitals. The lectures in medicine were held at Guy's; the lectures in surgery and anatomy were given in the lecture theatre at St. Thomas's. This association lasted until 1825 when feuding resulted in the establishment of a separate medical school at Guy's.

At the age of twenty-one - while still a student - he was appointed demonstrator of anatomy at St. Thomas's. Two years later - in 1791 - Cline thought so highly of him that he asked young Astley to share his lectures with him. At once Cooper made the innovation of delivering the surgical and anatomical lectures separately, the two having hitherto been regarded as one subject. At the start of his teaching career his lectures were too theoretical as was reflected in poor class attendance. Quickly realizing the cause of his failure, he began to illustrate his lectures with actual cases taken from the hospital wards, and it was not long before his classes attracted the largest number of students in all Europe.

In the same year Cooper married Miss Anne Cock, the daughter of a wealthy merchant. A year after the marriage Mrs. Cooper gave birth to their only child, who, however, died in infancy.

In 1793 he accepted the post at Surgeon's Hall as a professor of anatomy. His job consisted of dissecting publicly and lecturing on the bodies of criminals executed at the Old Bailey prison. He held this post successfully until 1796 when he resigned.

Finally, in 1797, he opened up his private practice, after having moved into Cline's former residence at number 12, St. Mary Axe.

His next step up the ladder of success was in 1800 when he became surgeon to Guy's Hospital, a job formerly held by his uncle. From this time forward, while he gave much of his time to the hospital and medical, his private practice rapidly increased until it became perhaps the largest any surgeon had ever had.



Throughout the active part of his career he was an untiring dissector. During these years he rose at six o'clock every day and then worked on his animal dissections until eight. In a speech to the Committee on Medical Education delivered towards the end of his career, he said "If I laid my head upon my pillow at night without having dissected something in the day, I should think that I had lost that day".

In the years 1800 and 1801 Cooper read two papers before the Royal Society on hearing. In the second paper he was the first to observe that deafness was in many cases due to depression of the membrana tympany, which in turn was caused by deficient air-pressure within the middle ear. For this work he received the Copley Medal, the society's highest honor. Only thirty-four years of age, this was no small accomplishment, especially when it is born in mind that Cooper's great teacher, John Hunter, was awarded the medal just seven years before his death.

Cooper's treatise on Hernias, which was one of his most famous works, was published in 1804. Even though it was written more than a century-and-a-half ago very few new facts can be added to it today. The publication of part II followed three years later.

At this time medical schools were confronted with a grave shortage of cadavers for dissection, and felt compelled to rely on the services of the Resurrectionists to help fill the supply by digging up and stealing bodies from graves. Cooper himself had much dealings with these men, and he once stated in evidence before the House of Commons' committee that "there is no person, let his situation in life be what it may, whom, if I were disposed to dissect, I could not obtain". It was only after he had retired that the passing of the Anatomy Act in 1832 put an end to this practice.

In 1806 Cooper moved into a house on New Broad street, where he spent the nine most financially rewarding years of his life. In one year he earned 21,000 Pounds.

Just as significant as his contributions to the knowledge of hernias were his studies and operations on blood vessels. Cooper performed perhaps the first ligation of the common carotid artery for aneurysm in 1805. The patient died, however, less than one month later, and he concluded that the diseased blood vessel wall must be operated on before it becomes an advanced case. Profiting from this experience he successfully carried out the same surgical procedure three years later on a carotid aneurysm. And on the same day he ligated the external iliac artery for femoral aneurysm. The first patient survived eighteen years and the second thirteen years. Nine years later - in 1817 - Cooper performed his most celebrated surgical feat, his ligation of the abdominal aorta upon a patient with a large iliac aneurysm. The patient lived only two days but Cooper demonstrated the feasibility of the operation.

Ever since his days as an apprentice, Cooper had been an active member of some medical society. In 1805 he played an important role in the founding of the Medico-Chirurgical Society, and was appointed its Treasurer. At the society's first meeting he read a paper on his first case of carotid ligation.

In 1813 Cooper was appointed professor of comparative anatomy by the Royal College of Surgeons and lectured during 1814 and 1815. Although he had studied comparative anatomy by constant dissection for many years, he still was not in a position to lecture on this subject without much additional preparation. This, together with all his other professional commitments frequently left Cooper with no more than three hours of sleep each night.

In 1820, Cooper was summoned to King George IV who had a sebaceous cyst on his scalp. Cooper operated on the English monarch and for this service he was made a baronet. Eight years later Cooper was appointed Seargent-Surgeon to George IV. He subsequently held the same position to William IV and the young Queen Victoria.

In 1822 was the year that saw the publication of his classic work on dislocations and fractures of the joints. In the same year he became an

examiner of the College of Surgeons.

At the age of 56 the many years of hard toil began seriously to affect his health and so he resigned his posts at St. Thomas's and Guy's in 1825. It had been Cooper's desire and understanding that his nephew, Bransby Cooper, was to occupy his position as lecturer at St. Thomas's on his retirement. When he did leave St. Thomas's, Mr. South became his successor, much to Cooper's astonishment. Since relations between the staff of the two institutions had been growing cooler for some time, Cooper induced Mr. Harrison, the treasurer of Guy's, to form a separate medical school at Guy's. When the medical school was founded in 1825 it marked the one-hundredth anniversary of the foundation of Guy's Hospital, with Bransby Cooper as lecturer of anatomy. Astley Cooper was made consulting surgeon to the new medical school.

In 1827 he received the supreme honor of his career on being elected president of the Royal College of Surgeons, thereby acknowledging his leadership of English surgery. Lady Cooper's death the same year came as a terrible blow to him, and he decided to retire from practice. By the end of the year, however, he resumed his work on a part-time basis, and in July 1828 married for the second time.

He died on February 12, 1841, at the age of seventy-two.

## DISLOCATIONS - GENERAL PART

In Cooper's days there were few other conditions where the reputation of the surgeon was so much at stake as in the treatment of dislocations. Numerous cases were seen in hospitals where dislocations and fractures had been confused with one another, and where practitioners had failed to recognize a dislocation until it was too late to reduce it.

It was undoubtedly Cooper's principal reason for writing "A Treatise on Dislocations, and on Fractures of the Joints" to reduce such instances of malpractice. It was published in 1822 and has been considered his most practical book. Written at the summit of his career, the treatise is the legacy of a lifetime of clinical observation, autopsies, teaching, general practice, animal dissections and experiments.

Nowadays, of course, x-rays offer an accurate means of diagnosing bone and joint injuries, but at that time no such exact and fully reliable method existed. Diagnosis was then made simply on the basis of clinical findings. The following are Cooper's observations on the diagnostic features of a dislocation:

"The instantaneous effect of a dislocation is a change in the form of the joint as well as in the length of the affected limb. The mobility of the joint is lost once the muscles have had time to contract. In the first moments after the injury the mobility is present, for I have seen a case in Guy's Hospital where the femur was dislocated in the foramen obturatum and was surprised that the bone was mobile in its dislocated position. However in less than three hours the limb became rigid as a result of muscle contraction. There is an extravasation of blood often found around the joint. At times this prevents easy recognition of the nature of the case. The dull pain accompanying the trauma results from the pressure of the head of the bone on the muscles. When a large nerve becomes compressed a paralysis of the limb distal to the



lesion could occur. This is occasionally observed in shoulder dislocations. The head of the displaced bone could usually be palpated in its new position - except in hip dislocations - and rotation of the head of the bone is often the most reliable characteristic of the injury. The natural protuberance of the bone of the joint either disappears entirely or becomes less striking to the eye, as, for example, the trochanter of the hip. Occasionally the opposite occurs as in cases of elbow dislocations whereby the olecranon juts out more than usual. Dislocations are often accompanied by a crepitus felt in the joint brought by the effusion of a sticky material (albumen) in the joint. The synovia is thickened and makes a creaking sound on motion".

As a student of John Hunter who created Surgical Pathology as a medical science, Cooper learned very early the value of autopsies in confirming diagnosis and improving treatment. Later on, as a general practitioner and a surgeon to Guy's Hospital, when a patient of his died he almost always performed a post mortem examination on him. And if the relatives of the deceased refused to grant permission for it, Cooper often sought the help of the Resurrectionists, so that in the end his passion for knowledge was usually gratified. The following is a general discussion of the pathological anatomy of a joint after dislocation:

"Examination of the body of a man who died following a dislocation caused by external force revealed that the head of the bone is completely removed from the joint cavity. The capsule ligament, the joint ligament as well as the ligamentum teres (in cases of hip dislocations) are torn. The tendon of the biceps, however, remains undamaged following a shoulder dislocation, as far as I have had opportunity to judge by autopsies, though I do not want to maintain that this is always the case.

The tendons which cover the ligaments are also torn, as for example the tendon of the subscapularis subsequent to a dislocation in the axilla. The more torn they are, the easier it is for the bone-head to slip out of the joint at some future time. Some muscles become shortened, others considerably stretched, as for example, the psoas and the iliacus internus as a result of an inferior

dislocation of the femur. At times muscles also tear, as for instance the pectineus and abductor brevis following an inferior dislocation of the femur".

Cooper observes that dislocations occur mostly as a result of pathological relaxation of surrounding parts or because of the action of external force when the muscles working on a joint are taken by surprise, so to speak, and therefore not prepared for resistance. These facts form the basis of his treatment.

Cooper was well aware that the main obstacle to overcome before replacing a dislocated joint is muscular contraction. He noticed that when a bone has been dislocated the muscles pull it as far away from the joint as the surrounding parts permit, and hold it there by means of contraction, the degree of which increases the longer one delays treatment. In his words,

"If an extension is undertaken immediately after the accident muscle resistance is easily overcome. If, however, the operation is put off for several days the reduction will be brought about only with the greatest difficulty".

And if the dislocation has been neglected for an even longer amount of time, Cooper cites three other circumstances to explain the great difficulty in treatment. First of all, in an old dislocation the end of the bone often becomes so firmly attached to the surrounding parts that even when the muscles are removed during the autopsy the joint cannot be reduced. Secondly, the joint cavity is at times filled with a ligamentous substance so that even if the bone is reduced it could not remain in its original position. And last of all, a new joint cavity often forms wherein the head of the bone is so firmly attached that nothing but a fracture of it could bring it out of its new position. For the reasons just mentioned, it was Cooper's opinion that in cases of shoulder and hip dislocation the maximum amounts of time allowed to pass from the date of injury past which it would be unwise to attempt reduction are three months and eight weeks, respectively.

Since muscle contraction represents the chief hindrance to successful treatment the surgeon's first concern, according to Cooper, should be to bring

about relaxation of the muscles. To this end, he recommends the combination of phlebotomy, warm bath and tartarised antimony. The patient is first bled of twelve to twenty ounces of blood, or more, and then placed in a hot bath until syncope is produced. While in the water the doctor administers a grain of tartarised antimony every ten minutes until nausea sets in. Although emetics were also employed at that time, Cooper lashes out against its use. While acknowledging its efficacy, he observes that as soon as nausea occurs muscle relaxation is produced. Thus vomiting in itself is useless from the therapeutic standpoint.

Once muscle relaxation is achieved in this manner, reduction of the bone follows by means of extension of the limb. In Cooper's day opinion varied as to whether the dislocated bone itself, or the bone distal to it should be extended. He favors the former way. To provide the force required for the manipulation Cooper recommends the use of either manual helpers or pulleys. In either case, the muscles must be extended slowly and gradually with an even and continuous force exerted. In addition, the limb must be maintained in a position between flexion and extension to insure relaxation of the stronger muscles. Cooper advocates the use of pulleys for the more difficult cases, as the practitioners can then determine the degree of force necessary, whereas if manual helpers are employed their exertions of force are often "sudden, violent, and in the wrong direction," which not infrequently resulted in tearing of the surrounding parts. Cooper criticizes contemporary surgical authors for not appreciating the value of pulleys in the treatment of such joint traumas.

## DISLOCATIONS - SPECIAL PART

### Dislocations of the Shoulder

As the most frequent dislocation in the body, it is only natural that Cooper had much experience in handling these cases. He classifies them according to the direction of displacement of the head of the humerus. Accordingly, there are inferior, anterior, and posterior dislocations of the shoulder.

In the inferior variety - or the dislocation in the axilla, the bone rests on the inner side of the inferior or lateral margin of the scapula.

The typical location of the head of the humerus in cases of the anterior dislocations is below the middle of the clavicle and at the sternal side of the processus coracoideus.

In posterior dislocations of the shoulder the head of the bone can be seen and palpated jutting out of the dorsal surface of the lateral or inferior margin of the scapula.

Cooper encountered the inferior dislocation most often. He states that the main diagnostic features of this injury are the sunken shoulder, the presence of the humerus-head in the axilla (this can be palpated when the elbow is raised) and the loss of the natural motion of the joint. To make the diagnosis, Cooper suggests asking the patient to raise his arm to his head. If he has such an injury he will not be able to do it. Also typical of this dislocation is that the wrist or forearm of the injured arm is supported with the other hand, preventing it from touching the patient's side in order that the dislocated bone does not press on the nerves of the axilla which would cause the patient intensive pain.

The chief cause of the inferior displacement is a fall on the shoulder on a rough surface whereby the head of the bone is pressed downward,



while the muscles are not well prepared to oppose the force of the impact.

Cooper dissected two recent cases of shoulder dislocations of this type. He writes:

"The second case I had opportunity to examine was one where the dislocation had already existed for five weeks and forceful attempts had been made to reduce the dislocated bone, but without success. The patient was a woman of fifty years. All signs were quite clear to recognize. The deltoid muscle was flattened and the acromion prominent. The humerus-head was palpable in the axilla. As a result of the attempt to reduce the dislocation the skin was rubbed off, and owing to the force which was used during the extension, the woman died. When the muscles were prepared it was observed that the pectoralis major was somewhat torn. The latissimus dorsi, the biceps, and the teres major were damaged. The supraspinatus was torn in different places. The infraspinatus and teres minor were torn, but not as much as the above mentioned muscles. Some fibers of the deltoid and coraco-brachialis were torn, but not as much as the supraspinatus.

After i had examined the injuries which the muscles had sustained, whereby I became acquainted with the resistance which they oppose extension, I proceeded to the examination of the joint itself.

The capsule-ligament was torn in the axilla between the teres minor and subscapularis. The tendon of the subscapularis was torn at its place of insertion at the tuberculum minus. The head of the bone was located at the axilla plexus and the artery. After examining these points by means of dissection, I tried to reduce the bone, but met with such resistance, however, that I could not bring it about myself, whereupon I became curious to discover the cause of this great resistance. I cut out one muscle after the other - the coraco-brachialis, teres major and teres minor, and the infraspinatus. The situation, however, changed hardly at all, for I still met with the same degree of opposition. Thinking that the deltoid muscle was chiefly responsible, I raised the arm in the air and relaxed this muscle, but I still could not reduce the dislocation. I cut out the deltoid and found out that the supraspinatus was responsible for the great resistance. For this reason I raised the arm straight up in the air, whereupon the head of the humerus slipped into the cavitas glenoidea. The deltoid and supraspinatus are therefore the muscles which in such cases oppose the Reposition the most.

From this dissection it follows that the arm should be extended at right angles or completely horizontally to the body, rather than in a diagonal and downward direction. These muscles, however, oppose the reposition the most of all. One can relax the biceps by bending the elbow somewhat. One can extend the arm straight outwards in a line between the pectoralis major of the outer side and the latissimus dorsi and teres major at the inner side. If we depart from this line somewhat, we could raise the arm higher in order to weaken the pectoralis major.

This dissection explains the reason why the arm is sometimes easy to reduce after the dislocation, when one raises it suddenly over the horizontal line and lays the finger under the head of the bone, in order to raise it towards the *cavitas glenoidea*, whereby it sometimes - as any beginner knows - can be easily reduced, because in this position the opposing muscles are so relaxed that it does not stand in the way of reposition".

Also of interest is the dissection of a dislocation which had remained unreduced a long time:

"The head of the bone had changed its form. The surface towards the scapula was flattened, a complete capsule ligament covered the head of the humerus. The *cavitas glenoidea* was entirely filled with a ligamentous substance, the result of a long inflammatory process. Small particles of bone were perceivable in this ligamentous substance which appears to be of new formation as no portion of the scapula or the humerus is broken. A new joint cavity for the head of the humerus formed at the *costa inferior scapulae*".

Concerning the treatment of this injury, Cooper recommends the heel-in-the-axilla method for all recent cases. We know that Hippocrates used this method to reduce shoulder dislocations, but Cooper's description and illustration of the heel-in-the-axilla method appear to be the first. He describes it as follows:

"The patient should be placed in the recumbent posture, upon a table or a sofa, near to the edge of which he is brought; the surgeon then binds a wetted roller round the arm immediately above the elbow, upon which he ties a handkerchief; then, with one foot resting upon the floor, he separates the patient's elbow from his side, and places the heel of his other foot in the axilla, receiving the head of the *os humeri* upon it, whilst he is himself in the half sitting posture by the patients side. He then draws the arm, by means of the handkerchief, steadily for three or four minutes, when in common circumstances, the head of the bone is thus easily replaced; but if more force be required, a long towel may be applied instead of the handkerchief, by which several persons may pull, the heel still remaining in the axilla. I generally bend the forearm nearly at right-angles with the *os humeri*, because it relaxes the biceps, and consequently diminishes its resistance. I have, in many cases, extended from the wrist, by tying the handkerchief just above the hand, but more force is required than in the former mode, although it has this advantage, that the bandage is less liable to slip. In recent cases it very rarely happens that this mode of extension fails, and it is so easily applied in every situation that I have recommended all our young men to employ it in the first instance, when called to this accident".

The method used at the present time is essentially the same except that the bandages are not utilized, the pull being effected by gripping the forearm at the wrist.

### Hip-Joint Dislocations

Injuries to the hip-joint represented a special diagnostic problem at the time. There were those who doubted that a hip dislocation could occur, and many who admitted its occurrence did not believe that it could be reduced. Furthermore, fractures and dislocations of this joint were especially often confused with one another, with catastrophic consequences for the patients.

Cooper had seen cases of dissected specimens of every variety of fractures and dislocations occurring in relation to the hip-joint and assigns to each condition with the greatest precision the various diagnostic points. He also summarizes accurately the differential diagnosis between a fracture and dislocation in this region.

Cooper's classification of hip dislocations consists of four varieties:

- 1) the superior displacement of the head of the femur towards the dorsum ilii
- 2) the inferior displacement in the foramen obturatorium
- 3) the posterior and superior dislocation in the incisura ischiadica
- 4) and lastly the superior and anterior displacement of the bone towards the body of the os pubis

The following are the characteristic clinical findings of the most common type of hip dislocation, the superior displacement of the femur towards the dorsum ilii: First of all, the injured limb is one-and-a-half to three-and-a-half inches shorter than the other one. Secondly, the knee and

foot are internally rotated, so that the toes on the side of the dislocation rest on the tarsus of the other foot. Thirdly, the leg is immovable as far as outward movement is concerned. In addition, the head of the femur can be seen when one rotates the knee internally. Another feature of this dislocation is that the roundness or arch of the dislocated hip has disappeared. And lastly, the trochanter does not jut out as much as the trochanter on the opposite side.

Cooper then discusses the differential diagnosis between this injury and the one with which it is most often confused - the intracapsular fracture of the hip (the details of which will be described in a later section). The latter is characterized by outward rotation of the knee and foot, the relative ease (though accompanied by some pain) with which the leg can be flexed in the direction of the lower abdomen, and above all the ease by which the injured leg, which is one to three inches shorter than its normal size, assumes its former length when it is passively extended. When, however, the clinician relaxes his grip on the leg, it becomes shorter again. Whereas the dislocation of the hip seldom occurs in advanced age, this fracture rarely is seen in people under fifty, and is the result of a very insignificant cause.

Cooper now turns his attention to the changes that the muscles undergo after an anterior hip dislocation towards the dorsum ili. The pyriformis, the triceps, pectineus, psoas major, iliacus internus, rectus, semitendinosus, semimenibransosus, obturator externus, and the head of the biceps are all very much shortened. The obturator internus, the gemini and the quadratus femoris are stretched. He observed that the muscles which oppose reposition most strongly are the glutei and the triceps.

The cause of this trauma is a fall or blow while the knee and the foot are rotated internally.

Concerning treatment, Cooper advocates using pulleys rather than manual helpers. While conceding that he has used manual helpers at times



in the past he says "but the force was so great, the extension so uneven that I am convinced that nobody who has ever reduced a hip dislocation by means of pulleys would have recourse to employ any other method". He also stresses the importance of preceding the extension with the combination of phlebotomy, hot bath, and a drug which produces nausea.

The following case history sums up all the important points of this variety of hip dislocation:

"William Newman, a strong, muscular man, almost 30 years of age, was brought to Mr. Astley Cooper in Guy's Hospital on the fourth of December 1812, because of a dislocation of the femur. On Thursday, the seventh of November he jumped from a coach. His foot slipped, and his hip struck against the wheel with great force. He then fell, and when it became clear that he was unable to walk, he was brought to the Kingston Workhouse, which was near the place where the incident took place. On the evening of the same day he was examined by a doctor, but the nature of the injury was not ascertained. He remained in Kingston until the thirty-first of November, whereupon he was brought to Guildford, his residence, and on the fourth of December he was brought to Guy's Hospital. The examination revealed that the head of the femur lay on the dorsum ili, the trochanter was drawn anteriorly, towards the anterior and superior spina iliaca of the ilium. The knee and foot were turned inwardly, and the extremity was one-and-a-half inches shorter than its former length. The large toe rested on the metatarsal bones of the other foot, and the leg was only slightly movable.

On Saturday, the seventh of December - thirty days after the accident - an extension was undertaken to reduce the leg. Before putting on the bandages he was bled to the extent of 24 ounces of blood. Ten minutes later he was placed in a warm bath, where he remained until he felt faint, which happened in 15 minutes. Then he was given a grain of tartarised antimony, which was repeated 15 minutes later, as the first dose did not produce nausea. At this point the patient felt the most intense urge to vomit. He did not vomit, however, and in this state of weakness he was brought into the operating room. Here he was placed on the left side of the table, the bandage was put on in the usual way, in order to fix the pelvis, and the pulleys were fixed to a strap around the knee. The leg was crossed over the other one in a diagonal direction not quite two thirds of its length.

The extension was continued for ten minutes, whereupon the bone slipped back into the joint cavity. The patient was discharged three weeks after his admittance to the hospital, having regained full use of the leg in a very short time".

## Dislocations of the Knee Region

### Patella Dislocations

Cooper observes that the patella can be displaced in three directions - superiorly, and to either side. Both the medial and lateral dislocations are characterized by an inability to bend the knee, and the protuberance of the patella at the medial and lateral condyli ossis femoris, respectively.

Regarding the chief cause of the lateral displacement, it usually occurs, according to Cooper, when someone falls while walking or running while the knee is internally and the foot externally rotated. Thus, due to muscle activity which attempts to prevent the fall, the bone is drawn over the lateral condylus ossis femoris. When the person tries to stand up he is unable to flex his leg. In addition, the muscles and ligaments of the patella are all greatly stretched.

Cooper states that the much less common medial dislocation results from a fall on the lateral side of the patella, or when the foot is rotated internally during the fall.

With respect to the reposition of these two dislocations, Cooper recommends a relatively uncomplicated procedure. The patient is placed in a supine position. A manual helper then takes hold of the heel and raises the leg so that it is extended to the maximum extent. At this point the surgeon presses down on the margin of the patella most distant from the joint. The pressure raises the inner edge of the bone over the condylus ossis femoris and it is then brought back into its natural position by means of muscle action. A volatile lotion of alcohol and water is applied and in two to three days the leg can be bandaged. It is soon capable to perform its usual work, though it is somewhat weaker than before.

## Dislocations of the Tibia in the Knee Joint

Cooper differentiates four varieties of tibia displacements of the knee.

There are:                      medial  
                                     lateral  
                                     anterior and  
                                     posterior

dislocations.

The medial and lateral varieties are partial dislocations and are only rarely encountered. In the former injury the tibia protrudes at the medial side of the joint so that the condylus ossis femoris rests on the lateral meniscus. We see the exact opposite findings in cases of lateral displacement of the tibia. Distinctive of both dislocations is the ease with which reduction is effected by means of straight extension.

Occurring more frequently than the two above mentioned injuries are the anterior and posterior displacements of the tibia. With respect to the anterior dislocation, the significant features, according to Cooper, are: the tibia is elevated, the femur however is depressed, and displaced somewhat to the side and posteriorly. The thigh-bone exerts such a pressure on the popliteal artery that the pulsation of the anterior tibial artery can hardly be palpated in the foot. The tibia and patella are drawn forward owing to the action of the rectus femoris muscle.

Concerning the posterior dislocation of the tibia, Cooper discusses the most important findings. As the name would suggest, the head of the tibia is displaced posterior to the condyli ossis femoris. In this injury the limb is shortened, there is a protuberance of the condyli ossis femoris, a depression at the patellar ligament, and the lower leg is bent forward.

The following is a typical case history of this injury:

"Mr. Luland, ..... a very strong and muscular man dislocated his shoulder and knee at the same time on January 4, 1796. The accident took place in the following way: While travelling in his carriage, the horse fell on the extremely slippery ground. Mr. Luland was thrown under the front transom of the coach and displaced the humerus in the axilla. The head of the tibia was completely dislocated posteriorly, being situated dorsal to the condyli femoris in the hollow of the knee. The tendon connecting the patella with the rectus muscle was torn, and the lateral condylus ossis femoris protruded considerably. The lower leg was shortened and there was a depression over the patella. The patient felt intensive pain when the leg was moved, but at rest the pain was negligible. The reposition was performed in the following manner: Two people held him from above, the one at the groin, the other at the shoulder, while two others held his leg a little above the ankles and extended in opposite directions. They gradually increased their effort until the bone was reduced. The patient was placed on his back, and Dr. Walshman reset the bone in its natural position. Dr. Walshman then put on a flannel bandage on the knee, put the patient to bed with the joint on a pillow and prescribed that the part be kept moist with a volatile lotion. He remained in this position for fourteen days free from pain. The doctor moved the extremity gently every day so as not to cause the patient any pain. In about a month Mr. Luland began to walk on crutches. Ten weeks after the accident took place he was able to sit up at lunch, and five months later he gave up the use of crutches and appeared entirely restored to health again, being able to use this leg as well as the other one. He died on the 18th February 1819 of dropsy".



## FRACTURES

### Fractures of the Shoulder

Cooper discusses three fractures of the shoulder which could easily be confused with the dislocation of the joint:

the fractures of the acromion  
the cervix scapulae  
and the neck of the humerus

Pertaining to the fractures of the surgical neck, it is the most frequent such injury of the proximal humerus. He observes that it occurs chiefly in older and younger individuals, but rarely in people of middle age. In the early age-group the break is located in the epiphyse, whereas in those patients advanced in years it is situated more distally in the bone. In such cases, according to Cooper, the head of the humerus remains in its natural position, while the body of the bone sinks into the axilla, where the end of the fractured bone-segment can be palpated. Owing to its insertion at the tuberositas deltoidea humeri, the deltoid muscle is drawn downward, so that the roundness or arch of the shoulder becomes less pronounced. Cooper points out that this fracture is easily confused with a shoulder dislocation, especially among older people, for in the declining years the injury very much reduces the flexibility of the joint and the change of position of the bone is far easier to bring about. To make the diagnosis, Cooper advocates the following: one grasps the head of the os humeri with the fingers, fixes it and rotates the arm at the elbow, and one discovers that the head of the bone does not rotate, being separated from the rest of the humerus by the fracture.

He estimates that the bone unites in three to six weeks after the occurrence of the injury.

The following is a brief case history. Cooper writes:

"Age, 10 years; Symptoms, inability to move the elbow from the side, or to raise the arm, except with the help of the other hand. The swelling, which later resulted, filled out the entire hollow that had arisen when the deltoid muscle was drawn downward. When the head of the bone was fixed, the broken end of the humerus under the deltoid could be moved back and forth, raising the arm at the elbow so that the broken end of the bone could be felt and seen. The grating of the ends of the bones on each other could not be perceived when the arm was rotated, but it could be heard when the bone was raised and moved away from the body. The fracture arose as the result of a fall on the shoulder in an eight foot deep saw-pit".

### Fractures of the Neck of the Femur

Cooper made an outstanding contribution to the knowledge of femoral neck fractures. In the early nineteenth century opinion varied with regard to the prognosis of these fractures. Many physicians of the day believed that they unite just as broken bones in other parts of the body, whereas some surgical men held the opposite view. Cooper takes issue with both standpoints.

He distinguishes between femoral neck fractures inside and outside the hip-joint capsule, which is of immense importance in that the clinical manifestations treatment and prognosis of these two fractures differ. Whereas the latter unites by bony union, animal experiments led him to the Conclusion that the bone fragments of the intracapsular variety fails to unite.

Cooper gives three reasons to explain this fact. First of all, there is faulty apposition of the two bone fragments due to their separation by muscular pull. He says "When the broken ends of any bone in the body are held apart, bony union is prevented". To prove his point he resected a segment of the radius of a rabbit, thereby creating a gap. Non-union resulted. In addition, he cut that part of the os calcis at which the Achilles tendon inserts from the rest of the bone, and fibrous (not bony) union took place. The second circumstance Cooper mentions is the lack of pressure which the two broken bone surfaces exert on one another brought about by the "effusion of synovia and fibrin in the joint". The third and last factor is concerned with the effect of the

incomplete blood supply to the head of the femur on the failure of bony union. Cooper writes:

"But the third and principal reason which may be assigned for the want of union of this fracture, is the almost entire absence of ossific action in the head of the thigh-bone when separated from its cervix; its life being supported by the ligamentum teres, which has only a few minute vessels, ramifying from it to the head of the bone. The structure of the arch of the thigh-bone, and parts surrounding it, is explained in the account of the anatomical plate connected with this part of my subject. But here it may be observed, that the neck and head of the thigh-bone are naturally supplied with blood by the periosteum of the cervix, and that when the bone is fractured, if the periosteum be torn through, to which there are very exceptions, the means of ossific action are, in consequence of such fracture and laceration, necessarily destroyed in the head of the bone. Scarcely any change therefore takes place in the head or neck of the bone attached to it; no deposit of cartilage or bone, similar to that of the other fractured bones, is produced". 1)

The importance of the factors pointed out by Cooper remains unchallenged.

Cooper also accurately summarized the differential diagnosis between the two fractures. Unlike the internal fracture, which seldom is seen in people under 50, the extracapsular variety frequently occurs in early life, and in adults under 50 years of age. Whereas the intracapsular fracture is the result of an insignificant cause, the external type is caused by violent injuries. Another difference is that the fracture outside the joint-capsule is characterized by a crepitus that is brought about by just slight movement of the leg. To produce the same sound in cases of internal fractures more vigorous movement - such as passive extension of the leg - is required. Furthermore, the pain associated with the extracapsular fracture is much more severe than that of the internal variety. Also, there is a greater amount of rotation of the leg seen in cases of the external fracture in comparison to the intracapsular type. Whereas in the intracapsular fractures the leg is shortened one to two inches, it is only seldom that the leg of a patient with the external fracture is one inch shorter than its former length. Finally, the extracapsular fracture does heal by bony union in a period of eight to twelve weeks, the reason being that the two bone

1) quoted from Brock p.90

fragments are firmly pressed against one another.

The case history of a patient with an extracapsular femoral neck fracture now follows:

"Mary Clements, age 83 and-one half years caught her cane in a hole in the floor by mistake, whereby she lost her equilibrium, and while trying to regain her balance to prevent the fall, which would have happened if people standing nearby had not held her, she noticed that she, according to her opinion, had dislocated her thigh-bone. When I was called to her she lay on the bed, had much pain, the leg was shorter and the foot was externally rotated. I immediately assumed the nature of the injury and ordered an extension from the foot, hence it followed that the leg could be brought to the same length as the other. When I rotated the leg, I discovered a crepitation, which confirmed my opinion that the neck of the femur had been broken. With the intention of effecting an union of the bone, I straightened the leg and produced a continuous extension in such a way that i fixed the pelvis and extended the leg from the ankle. As however she was just as weak mentally as physically and she could not be moved to let the extension be continued, I was forced to change my plans after a few days, and in such a manner that I tied to boards at right angles to one another, over which I laid her leg supported by pillows, the position of which I maintained by means of a side lever. In a few days this position, which had been very comfortable for her in the beginning, became so painful, that she could not keep it up, and I had to give up my plans to help her. From this time on she stayed in a position that was comfortable to her. For the most part she felt the greatest relief lying on the injured side, with the leg drawn up in the air at right angles to the body. In the beginning the parts around the joint were kept moist with an evaporating lotion. The normal activity of the intestinal canal was stimulated by means of the occasional use of mild laxatives. And before going to bed in the evening she usually took pain-killing pills for an old cronic cough. For some weeks I was able to extend the leg, but afterwards this was no longer possible, probably, as I believe, because of the permanent contraction of the pelvic muscles. My conclusion was based on the fact that the other leg which she had flexed at the knee at the same angle, was also immovable. When she had become completely bedridden, in which condition of weakness she was very near before the injury, she developed a decubitus ulcer, but suffered no further discomfort. Her health in general appeared as good as before, and she died finally, without any symptom of an acute disease about 15 months from the time of the accident".



### Fractures of the Knee Joint-Patella

Cooper's classification of patella fractures consist of transverse and longitudinal fractures. He recognized that the transverse type is the most frequent one. In such cases the proximal fragment is raised due to the action of the rectus muscle which inserts at the upper part of the bone. The lower bone fragment, however, remains in its natural position by means of the patella ligament. He makes the point that the degree of separation of both parts of the patella depends on the extent of the tear of the membrane (the outer layer of the joint capsule). The gap could vary from one-half inch to five inches, according to the amount of damage to the membrane.

He points out that the injury can be immediately diagnosed by the depression between both portions of the bone. Besides, the defect in the patella can be easily palpated. The ability to extend the leg is lost, as well as the ability to rest the weight of the body on the leg while walking for the leg bends forward on account of the loss of the action of the extensor muscles. In a very few hours after the injury an extravasation of blood forms in the anterior part of the joint giving the region a blue appearance. This disappears in a few days. He calls attention to the fact that no crepitus is produced in transverse fractures of the kneecap because the bone fragments cannot be brought close enough together. Also typical of this injury is that it is not associated with a great amount of pain.

Cooper says that the fracture could be caused by a fall or a blow on the bone. The injury could also be caused by the activity of the extensor muscles on the kneecap.

He then illustrates with a case history how a fracture could be caused as a result of muscle action. " A lady who was walking down the stairs, put her heel on the edge of the step and was in danger of falling when she bent her body backwards to prevent the fall, and stretched her knee and hereby broke her patella".

His explanation of the mechanism of the injury is as follows: when the knee is bent the patella is drawn down to the end of the condyli so that the upper margin of the bone is brought forward. It is at this moment that the patella breaks when the rectus muscle is not in a straight line, but rather almost at right angles to it.

Cooper demonstrated by experiments on rabbits and dogs that the transverse fracture of the patella heals by fibrous and not bony union.

He writes:

"First Experiment:

I pulled the skin away, cut through it, placed a knife on the patella, and struck it not very forcefully with the handle. The bone was broken and at the same time drawn upward. I let go of the skin and noticed that the wound did not lie opposite the fracture. Twenty-four hours later I killed the animal and examined the part. The bone fragments were separated from each other by three-fourths of an inch and the space was filled with coagulated blood.

Second Experiment:

I repeated the same experiment and killed the animal on the eighth day when I found most of the blood absorbed and an adhesive substance occupying the space between the bone pieces.

Third Experiment:

I repeated the same experiment and examined the animal on the fifteenth day. The adhesive substance had assumed a smooth and somewhat ligamentlike quality.

Fourth Experiment:

The same experiment of the bone was made and examined on the twenty-second day, at which time the new ligament was complete.

Fifth Experiment:

The same repeated five weeks later. The part was injected and vessels were discovered running from the edge of the ligament to the formerly adhesive, now however ligamentous substance. So, in the course of five weeks the formation of vessels is complete, and some vessels romify from the bone and sink into the ligament. One can observe this process just as well in dogs, but it does not proceed so quickly in big dogs as in rabbits.

Sixth Experiment:

After I had separated the bone in a rabbit, I sewed the two portions of it together but the ligatures tore apart and the bones were united by means of fibrous union.

Seventh Experiment:

I separated the bone and cut through the rectus muscle, and yet the patella united by means of fibrous union".

The principle of treatment according to Cooper, is to make the ligament as short as possible by bringing the two bone pieces as near to one another as possible by means of two leather straps. For a large gap between the bone fragments results in a shortening of the rectus muscle which in turn causes a decrease in strength of the muscle.

SUMMARY

Sir Astley Cooper (born August 23, 1768, and died February 12, 1841) descendent of a family of surgeons and pupil of Cline and John Hunter, distinguished himself as a surgeon and professor at various London hospitals by making the most famous contributions to the art of diagnosis and operation-technique in English medicine during the first half of the nineteenth century.

Besides the compendium on hernias his treatises on dislocations and fractures can be considered fundamental to the modern surgery of the skeletal system. His teachings on these two groups of injuries are illustrated in words and pictures.

Bibliography

- 1) Bailey & Bishop: "Notable Names in Medicine and Surgery"  
3rd Ed., London 1959; H.K. Lewis & Co. Ltd.
- 2) Bishop: "The Early History of Surgery", 1960;  
Robert Hale Ltd. (Trinity Press)
- 3) Brock: "The Life and Work of Astley Cooper"  
E. & S. Livingstone Ltd., Edinburgh and  
London 1952
- 4) Cooper: "Abhandlungen über Luxationen und Frakturen"  
Weimar, 1823
- 5) Cooper: "Chirurgische Abhandlungen und Versuche"  
Weimar, 1821
- 6) Gurlt: "Geschichte der Chirurgie", Berlin 1898
- 7) Power: "Astley Cooper", from the "Dictionary of  
National Biography", London 1886, p. 137
- 8) Tilanus: "Surgery 100 Years Ago", 1925









